

**A DISSERTATION ON COMPARISON OF THE
RESULTS OF OUTCOME OF CANAL WALL UP
MASTOIDECTOMY AND CANAL WALL DOWN
MASTOIDECTOMY FOR CHRONIC SUPPURATIVE
OTITIS MEDIA**

**DISSERTATION SUBMITTED FOR
MASTER OF SURGERY BRANCH (IV)
IN
OTORHINOLARYNGOLOGY
MARCH 2010**



**THE TAMIL NADU DR.M.G.R. MEDICAL UNIVERSITY
CHENNAI – TAMILNADU**

DECLARATION

I hereby declare that this dissertation entitled **“COMPARISON OF THE RESULTS OF OUTCOME OF CANAL WALL UP MASTOIDECTOMY AND CANAL WALL DOWN MASTOIDECTOMY FOR CHRONIC SUPPURATIVE OTITIS MEDIA”** has been prepared by me under the guidance and supervision of **DR.K.R.KANNAPPAN M.S.D.L.O.M.ch, PROFESSOR AND HEAD OF THE DEPARTMENT OF OTORHINOLARYNGOLOGY, Govt Rajaji Hospital, Madurai.**

This Dissertation is Submitted to The Tamil Nadu Dr.M.G.R medical university in partial fulfillment of the university regulations for the award of **“THE MASTER OF SURGERY”** in OTORHINOLARYNGOLOGY. this work has not formed the basis of the award of any degree/ diploma to me previously by any other university.

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CERTIFICATE

This is to certify that the thesis titled “**A DISSERTATION ON THE COMPARISON OF RESULTS OF OUTCOME OF CANAL WALL UP MASTOIDECTOMY AND CANAL WALL DOWN MASTOIDECTOMY FOR CHRONIC SUPPURATIVE OTITIS MEDIA**” submitted by **DR. VIDHYA.M** under my supervision & guidance in partial fulfillment for the award of the degree of **Master of Surgery in Otorhinolaryngology** by the Tamil Nadu Dr. M.G.R. Medical University, Chennai, is a bonafide record of the work done by her during the academic period 2007-2010. She has evinced keen interest in collecting the cases from the ward and analysing them. I have great pleasure in forwarding it.

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ACKNOWLEDGEMENT

I would like to express my most sincere thanks to the following persons who went the extra mile to help me complete this dissertation.

“The function of a teacher is not to tell only the meaning of words, but to knock the doors of mind”.

I am highly indebted to my guide **Dr.K.R. KANNAPPAN MS, DLO, M.Ch, Professor and Head of Department of OTORHINOLARYNGOLOGY**, Govt Rajaji Hospital, Madurai., a true teacher who taught me not only the art of surgery but also the etiquette of a surgeon without whose guidance this work would have remained an inconceivable dream.

I gratefully acknowledge and sincerely thank **Prof.Dr.S.M. SIVAKUMAR**, Dean, Govt Rajaji Hospital, Madurai, for granting me permission to utilise the resources of this institution for my study.

I express with a deep sense of gratitude, my sincere thanks to **Dr. S.SARAVANA MUTHU M.S., E.N.T**, Associate professor, Govt Rajaji Hospital for his encouraging directions and coaching throughout.

I am very much obliged to **Dr. ARULSUNDARESHKUMAR M.S** and **Dr.RAJAGANESH M S** , Asst Profs of Dept of ENT , who helped me in preparing and bringing a shape to this work..

I am also grateful to Asst Profs of Dept of ENT **Dr.RAJASEKARAN M.S DLO, Dr. ALAGUVADIVEL MS DLO, Dr. SIVS SUBRAMANIAN MS DLO** and **Dr.RADHAKRISHNAN MS DLO** for their help and guidance.

I acknowledge with thanks, the unflinching support rendered by my post graduate colleagues & friends.

I wish to record my sincere respect and thanks to all those patients who despite their agony and suffering have helped me in moulding this study.

Last but not the least I would like to thank my husband and parents in providing me utmost cooperation needed for this study.

Place:

Date :

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*PROFORMA

*MASTERCHART

*KEY TO MASTER CHART

INTRODUCTION

The chronic discharging ear is still one of the common problems that the Otorhinolaryngologist in India and other developing countries are encountering. Although, thanks to the advent of newer antibiotics, the incidence of acute suppurative otitis media and its complications have reduced, chronic suppurative otitis media and their complications are still prevalent.

The continuation of the infection and the bone eroding properties of granulation tissue and cholesteatoma seen in CSOM are known to be the major pathological process causing these complications. As there is no simple means to eradicate this chronic pathology, appropriate and timely intervention by an otologist goes a long way in the prevention of these human maladies.

In cases of chronic suppurative otitis media with atticointral / postero superior marginal pathology, treatment modality is only surgery. Surgical options available are the canal wall down mastoidectomy and intact canal wall mastoidectomy.

Goals of surgical management of chronic otitis media include the eradication of disease, restoration of hearing, and, to the extent possible, maintenance or restoration of a normal anatomic

configuration. Prior to the mid-1950s, the first 2 of these goals were usually accomplished by removal of the posterior external auditory canal wall, resulting in a radical or modified radical mastoidectomy cavity. The past 50 years have witnessed a trend away from mandatory canal wall removal. Many otologic surgeons now prefer intact canal wall mastoidectomy with tympanoplasty except when canal wall removal is required because of extensive disease, inadequate access for cholesteatoma excision, operation on an "only hearing ear," or uncertainty of adequate follow-up. The popularity of intact canal wall mastoidectomy stems from the benefits of maintaining a canal wall, which include freedom from the need for frequent mastoid bowl cleanings, freedom from water intolerance and calorically induced vertigo, and less difficulty in fitting and use of hearing aids.

In canal wall down mastoidectomy, complete disease clearance can be given. But this could be achieved only at the cost of post operative cavity problem and considerable hearing loss.

Though these complications are not present in intact canal wall mastoidectomy, disease clearance could not be achieved completely in intact canal wall technique.

Though the complications of CSOM can be averted , still they are on the rise due to poverty, ignorance of the patient and the non

availability of facilities on time. Therefore there is a need to make public aware of the serious nature of this illness, the importance of early diagnosis and managing so as not only to reduce the morbidity and mortality but also to give them safe, dry and functioning ear.

The present study has been carried out to compare the post operative results of canal wall up mastoidectomy and canal wall down mastoidectomy in patients with atticotympanic or postero superior marginal pathology of chronic suppurative otitis media.

AIMS OF THE STUDY

1. To perform on CSOM patients, canal wall down mastoidectomy and canal wall up mastoidectomy.
2. To follow up the patients post operatively by clinical examination, otoendoscopy and pure tone audiogram.
3. To study the post-operative results like recurrence of ear discharge, improvement in hearing and requirement of post operative follow up.

REVIEW OF LITERATURE

The history of Chronic Otorrhoea and its complications are as old as the human race itself. Some of the Mummies found in the pyramid show evidence of middle ear infection. The earliest written history of ear discharge and its treatment are found in 'PAPYRUS EBEARS' written more than 1500 years BC. It describes treatment with olive oil sprinkled with spells.

Atharvana veda of 700 BC contains the earliest Indian medical information including ear disease.

Sushrutha the Indian physician of 500 B C has written in detail about CSOM describing it as 'Pooti Karna' and is the first person to describe its complications. He says that if 'Pooti Karna' is not treated properly, the patient may develop hallucinations and vomiting. He not only used herbal tonics and ear drops but also devised many surgical instruments to drain an abscess when it is pointing and to pack the cavity daily with herbal medicines.

Hippocrates, the Father of Medicine (460BC), was probably the first to inspect the tympanic membrane as dry thin spun web and to recognize it as a part of organ of hearing. He mentioned that the patient

with acute ear pain and high continuous fever may become delirious and die.

Medicines used till 1500 AD were honey, breast milk, one's own urine, bull's urine, rain water, etc..

Gabriel Fallopious (1523-62) discovered the facial nerve canal and also described the aural polyp and its treatment.

Joseph Dureuney (1648-1730) remembered as the Father of Otology gave an account of scientific explanation with the tympanic cavity.

Glovauni-Morgagni (1682-1771) was the first to clearly recognise that the ear infection came first and the brain abscess was secondary.

Morand S.F (1768) successfully operated upon a brain abscess for the first time.

Hooper in 1826 first described 'lateral sinus thrombosis' from middle ear infection.

William wilde in 1853 described the sub periosteal abscess and popularized the concept of draining it with a post aural incision.

Herman an Schwartz in 1870 first published a report of having opened the mastoid antrum. So well did Schwartz succeed, that by 19 th

century it attained a general acceptance and came to be known as Simple or Cortical Mastoidectomy.

Emanuel Gault in 1890 described the technique of Radical Mastoidectomy in detail and in 1891 Stacks advocated plastic meatal skin flap for drainage. Then the Radical mastoid operation came to be known as Gault or Stack operation.

Johannes Kessel in 1885 had done the first endaural Radical Mastoidectomy.

Lane .W.A in 1890 established the surgical treatment for sinus thrombosis.

Korner O.in 1902 demonstrated that infection can spread from the lining mucosa of tympanum , through intact bone by means of progressive thrombophlebitis.

It was Giuseppe Gradenigo who in 1907 described a symptom complex consisting of Abducent Nerve in patients with suppurative disease of the petrous apex.

Bezold F.S in 1908 described that infected air cells perforating the inner surface of mastoid process can extend to the deep tissues of neck calling it as “ Bezold’s abscess”.

Though the concept was very old, the first mastoid operation trying to preserve the ossicular chain and hearing was described by Bondi in 1910.

The credit for the first successful intra-temporal facial nerve anastomosis and first successful facial nerve graft within temporal bone in 1930 goes to Sterling Bunnell.

From 1930-1937 Kopetsky, Almor, Eagleton, Frenchkner, Ramadier and Lempert described the various routes for draining the petrous apex.

Alexander Fleming in 1928 discovered the antibiotic Penicillin which revolutionized the treatment of CSOM.

Gerhard Domagala discovered Sulphonamides in 1932 and since then many more useful broad spectrum antibiotics have been introduced.

The reconstructive surgery to create a sound conductive system and tympanoplasty operations started with Zollner in 1951 and Wallstein in 1952.

Heerman in 1958 used temporalis fascia graft for tympanic membrane perforations.

The invention of computerized axial tomography by Godfrey Hounsfield in 1972 is described as the greatest step in the field of radiology, after the invention of X- ray by Roentgen in 1895.

The basic principles of magnetic resonance imaging was conceived by Bloch and Purcell in 1946 ; but it was Damadian and Lauterbur in 1973 who indicated its application in obtaining images in the intact human body.

The development of Argon Laser microscope is considered as the greatest advancement in the field of middle ear surgery, invented by Rodney.C. Perkins in 1978.

In 1987 studies of Rubin R. showed that environmental factors in addition to genetic factors exert a strong influence on the development and ultimate size of mastoid air cells.

Aurim R.Eden in 1987 found preliminary evidence of neural control of middle ear aeration controlled by respiratory centre.

Gates G.A in 1988 found out that Adenoidectomy in children significantly reduced nasopharyngeal bacterial flora irrespective of the size of adenoids and is beneficial for controlling middle ear infection.

In recent years many have studied the problems complications of CSOM and further contributed to its better understanding .Browning .G.G says that all active cases of CSOM with and without

Cholesteatoma, and whether or not they had previous surgery, should be considered as liable to lead to major complications.

Even today the debate is still on, regarding an open or closed technique to be adopted for eradicating cholesteatoma .The opinion seems unanimous in a case of complication of CSOM, that the eradication of the pathology from the middle ear is more important than its auditory function.

SURGICAL ANATOMY OF MIDDLE EAR CLEFT

The middle ear cleft consists of the tympanic cavity, the Eustachian tube, the mastoid air cell system and extension of the air cell system into anterior and posterior petrous apex.

The tympanic cavity

It is an irregular laterally compressed air filled space in the temporal bone, lined by mucous membrane. It is hour glass shaped with a volume of about 2 cubic cm. For descriptive purpose it may be thought of as a box with four walls, roof and floor.

The lateral wall of tympanic cavity

The tympanic membrane forms the central portion of the lateral wall, while above and below there is bone, forming the outer lateral walls of epitympanum and hypotympanum. Superiorly the scutum separates the epitympanic recess from the roof of the external auditory canal. Inferiorly a part of tympanic bone separates the tympanic cavity from the medial part of temporomandibular joint. The pearly white tympanic membrane is 0.1 mm thick and forms an angle of 55° with the floor of meatus, is oval in shape, slightly broader above than below. Its longest diameter from posterosuperior to anteroinferior is 9.1 mm, perpendicular to this is the shorter diameter, 8.9mm. The

circumference of pars tensa is thickened to form a fibro-cartilagenous ring-the tympanic annulus, that sits in the tympanic sulcus. From the superior limit of sulcus, the annulus becomes a fibrous band which runs centrally as anterior and posterior malleolar fold to the lateral process of malleus. The lax area above this fold,that does not have annulus is pars flaccida. Below these malleolar folds is the pars tensa.

In pars tensa, the lateral most collagen fibres of the Lamina propria, which are in direct contact with the basement membrane of the epithelial layer, are arranged in regular radial orientation. These fibres are believed to direct the migration of epithelium from the surface of tympanic membrane to the outside. The upper limit of tympanic sulcus is marked by anterior and posterior canaliculus for chorda tympanica nerve which traverses the middle layer of tympanic membrane at the level between malleus and incus. The anterior canaliculus is at the medial end of the petrotympanic fissure which lodges the anterior ligament of malleus and admits the anterior tympanic artery. The posterior canaliculus is situated at the junction of lateral and posterior wall at the level of upper end of handle of malleus. The opening leads to a bony canal that descends through the posterior wall. It descends obliquely and joins the nerve. A branch of stylomastoid artery accompanies the nerve.

Arterial supply is through the deep auricular branch of maxillary artery, anterior tympanic branch of maxillary artery, twigs from the stylomastoid branch of posterior auricular artery and from the middle meningeal artery.

The venous drainage occurs through the external jugular vein, transverse sinus, dural veins and venous plexus around the Eustachian tube.

Nerve supply is from the auriculotemporal nerve supplying anterior portion, auricular branch of vagus supplying the posterior portion and tympanic branch of glossopharyngeal nerve supplying the medial surface.

Roof of the tympanic cavity

It is a thin plate of compact bone, the tegmen tympani, that separates the middle cranial fossa from the tympanic cavity. It is formed by petrous and squamous bone and the petrosquamous suture. This suture is unossified in the young and does not close until adult life. Veins from the tympanic cavity running to the superior petrosal sinus pass through this line and this may allow infection to spread into middle cranial fossa.

Floor of tympanic cavity

It is much narrower than the roof and consists of a convex plate of bone separating the cavity from the superior bulb of internal jugular vein. Occasionally the bone is deficient and the uncovered vein may come up to the level of tympanic membrane covered only by mucous membrane and fibrous tissue and lie in a dangerously exposed position from the point of view of middle ear disease and surgery. The floor sometimes may be thick and contain some accessory air cells. Anteromedial to the vein, the tympanic branch of glossopharyngeal nerve pierces the floor.

Medial wall of tympanic cavity

The medial wall is the lateral wall of the inner ear. The basal turn of the cochlea forms a rounded elevation called promontory, occupying much of the central portion of the medial wall. The promontory surface is grooved by filaments of tympanic plexus. Behind and below the promontory is the oval window leading to vestibule, but in life is closed by the base of stapes and its surrounding annular ligament. The round window lies below and behind the oval window, separated by an extension of promontory called subiculum. Occasionally a spicule of bone leaves the promontory above the

subiculum and runs to the pyramid on the posterior wall of tympanic cavity. This spicule is called ponticulus. The round window is covered by secondary tympanic membrane of 0.7mm thickness. The facial nerve runs above the promontory and turns inferiorly behind the oval window to descend in the posterior wall. Above the facial nerve, in the epitympanum, is the dome of lateral semicircular canal. The triangular area posterior to the round window is the sinus tympani which can have cellular communication with the mastoid process and is thus of significance in the pathology and surgery of the tympanic cavity, as it can lodge cholesteatoma hidden during surgery.

Anterior wall of tympanic cavity

It is a narrow wall, as the medial and lateral walls of the tympanic cavity converge. In the superior portion, there are two canals, one for tensor tympani above and the Eustachian tube below. The septum between them extends backwards and forms the processus cochleariformis on which the tendon of tensor tympani glides. The inferior part of the anterior wall consists of thin bony lamina forming posterior wall of carotid canal and is perforated by superior and inferior caroticotympanic nerves and the tympanic branch of internal carotid artery.

Posterior wall of tympanic cavity

It is wider above than below and has in its upper part an opening - the aditus-into the mastoid antrum. This is a large irregular hole that leads backwards from the posterior epitympanum. Below this is the fossa incudis, housing the short process of incus and the ligament connecting the two. Below the fossa incudis and medial to chorda tympani opening is the **pyramid** housing the stapedius muscle. The bony portion of the posterior wall below the pyramid is the pyramidal recess which may be perforated by air cells communicating with the mastoid process. The facial nerve as it descends here is in danger from air cells infection and from surgical attempts at air cells extirpation. Between the promontory and the tympanic annulus is the **facial recess**. Deep to both promontory and the facial nerve is the posterior, extension of the mesotympanum, the **sinus tympani**. The importance of facial recess is in posterior tympanotomy operation where an access to middle ear from mastoid is made between facial nerve and chordatympani nerve.

Contents of tympanic cavity

The tympanic cavity contains a chain of the small movable bones - the malleus, incus and stapes, two muscles, the chordatympani and tympanic plexus of nerves.

The malleus has a head, neck, two processes and a handle. The head lies in the epitympanum and has a superior ligament which runs to the tegmen tympani. Its posteromedial surface shows a facet for the incudomalleolar joint. The anterior process receives a ligament from the petrotympanic fissure, and the lateral process receives anterior and posterior malleolar folds from tympanic annulus. The handle is embedded between the mucosal and fibrous layers of tympanic membrane and its rounded end forms the umbo. Tensor tympani tendon is inserted on the deep surface of handle near its upper end.

The incus has a body and two processes. The body lies in the epitympanum and has a cartilage covered facet for the incudomalleolar joint. The short process projects backwards to fossa incudis, from which it receives a ligament. The ligament of incus is little more than a fold of mucosa. The tip of long process – the lenticular process is directed medially and forms a ball and socket joint with the head of stapes.

The stapes consists of head, neck, two crura and a foot plate. The stapedius tendon is inserted into the neck. The two crura arise from the neck, and join the foot plate which covers the oval window and is attached to its margins by the annular ligament of base of stapes.

The muscles of the tympanic cavity help in stabilizing the ossicles, augmenting the sound signals and in protection of the inner ear. The tensor tympani and stapedius are stimulated into activity by sound and acting in combination, they exert a dampening effect on amplitude of vibratory wave protecting the cochlea from excess stimulation. The tensor tympani by pulling the tympanic membrane medially may contribute to the functional role of the tensor palati in cleaning the middle ear when the auditory tube is opened.

Compartments of middle ear

The middle ear is divided into three compartments: The mesotympanum, epitympanum and hypotympanum.

The mesotympanum

It is that portion of the middle ear that lies between horizontal plates drawn at the top and bottom edges of parstensa. It contains stapes, long processes of malleus and incus, oval and round windows. It contains stapes, long processes of malleus and incus, oval and round

windows. The eustachian tube exits from its anterior aspect. While most of the mesotympanum is readily accessible to surgeon, two crescent shaped recesses are extended posteriorly that are often impossible to visualize directly. These spaces, the facial recess and sinus tympani are the most common locations for cholesteatoma persistence after chronic ear discharge surgery.

The epitympanum (attic)

It is that portion of the tympanic cavity that lies above the short process of malleus. Superiorly it is bounded by tegmen tympani, medially by the prominence of lateral semicircular canal and the horizontal part of facial nerve, laterally by the scutum and posteriorly by fossa incudis. It contains the head of malleus, body of incus and their associated ligaments and mucosal folds. The epitympanum lies within a fan shaped dehiscence on the tympanic bone – notch of rivinus. It is bounded posteriorly by tympanomastoid line and anteriorly by tympanosquamous line. The tympanic membrane here is deficient of the dense fibre that forms the middle layer of pars tensa. Because the pars flaccida lacks this structural support, it is more prone to retraction in the face of negative middle ear pressure. This helps to explain the propensity for cholesteatoma to form in the epitympanum.

The hypotympanum

It is that portion of middle ear that lies below the floor of bony ear canal. It is an irregular bony groove that is seldom involved by cholesteatoma. Occasionally the bone covering the jugular bulb may be dehiscent in the hypotympanum.

Mucous membrane of middle ear cleft

The lining of the middle ear spaces is an extension and modification of the respiratory mucous membrane that lines the nasal cavity, nasopharynx and Eustachian tube. In all these regions the mucous membrane consists of a layer of ciliated columnar cells with a subepithelial layer of connective tissue. A film of mucous clothes the membrane and is replenished by strategically located goblet cells and mucous glands. The mucous film is kept in constant motion by the continuous action of cilia, the direction of movement of the cilia being from the tympanic cavity into the nasopharynx. A thin delicate mucous membrane lines the whole of middle ear cavity and is reflected onto the ossicles and tendons. It is continuous with the mucous membrane of the mastoid antrum and Eustachian tube. It consists of non-ciliated cuboidal epithelium, two or three cell deep, without a basement membrane, but becomes ciliated columnar type especially near the

opening of Eustachian tube and hypotympanum, and changes to flat pavement epithelium in the attic and air cells.

As one progresses from the cartilagenous to the bony portion of Eustachian tube and from the tympanum to the antrum and air cells, the sub epithelial connective tissue becomes thinner until the pavement epithelium and the periosteum together form a thin delicate membrane. The property to produce mucous is largely lost in the pavement epithelium. These differences in the thickness of the mucous play an important role in the genesis of 'benign' tubotympanic otitis media and 'dangerous' atticotympanic type of disease.

Mucosal spaces of the middle ear

The mucous membrane is thrown into a series of folds by the intratympanic structures dividing the middle ear into mucosal spaces of surgical importance. The ossicular chain, ligaments, tendons of tensor tympanic and stapedius muscles and the chorda tympani nerve are called the 'viscera' of the middle ear and the mucosal folds are the mesenteries. The attic is almost completely separated from the mesotympanum by the ossicles and their folds except for two small but constant openings called isthmus tympani anticus and isthmus tympani posticus.

The transversely placed superior malleolar fold divides the attic into a small anterior malleolar space which lies above the tensor tympani fold that may prevent cholesteatoma from the attic reaching the anterior mesotympanum and a larger posterior compartment. The posterior compartment is further subdivided by the superior incudal fold into a superior incudal space (lateral to the fold) and a medial incudal space. The entrance into the Prussak's space is usually located between the lateral malleolar fold and lateral incudal fold. This latter fold may arrest the passage of cholesteatoma, through a posterior superior marginal perforation, into the attic.

The inferior incudal space

It is limited superiorly by the lateral incudal fold, medially by the medial incudal fold, laterally by the posterior malleolar fold and anteriorly by the interosseous fold, which lies between the long process of incus and upper two thirds of the handle of malleus.

The anterior pouch of Von Troltsch

Lies between the anterior malleolar fold and that portion of the tympanic membrane anterior to the handle of malleus.

The posterior pouch of Von Troltsch

Lies between the posterior malleolar fold and that portion of the tympanic membrane posterior to the handle of malleus.

Prussack's space

It is small space lying between the neck of malleus medially and the pars flaccida laterally. It is bounded below by the short process of malleus and above by the fibres of lateral malleolar fold, which fan from the neck of malleus to be inserted along the entire rim of the notch of Rivinus. A cholesteatoma may extend from Prussack's space, under lateral incudal fold, into the posterior mesotympanum.

The mucosal folds may limit the infection to one or several of the compartments in the middle ear and if the disease is thus limited it may be possible to control it in the affected compartment while preserving the integrity and function of the adjacent structures.

From the Prussack's space cholesteatoma may spread in three directions.

Posterior route.

This is the commonest route. The extension would be into the superior incudal space lateral to the body of incus which lies in the

posterolateral portion of the attic. From here it penetrates the aditus and gains access to the mastoid.

Inferior route

This occurs frequently into the inferior incudal space or posterior pouch of Von Troltsch into the posterior mesotympanum. Cholesteatoma may then spread to the region of stapes, round window, sinus tympani and facial recess.

Anterior route

It is less common. Penetration anterior to the malleus head leads to involvement of the anterior epitympanum and supratubal recess. Downward growth into the anterior mesotympanum may occur via the anterior pouch of Von Troltsch.

Connection between middle ear and mastoid

A series of mucosal folds and suspensory ligaments, known as the tympanic diaphragm, nearly separates the mesotympanum from the epitympanum and mastoid. The major components of this partition are the malleus head and incus body, lateral and medial incudal folds, anterior and lateral malleolar folds, and the tensor tympani fold. Only two narrow passages anterior and posterior tympanic isthmus breach

this diaphragm. The anterior tympanic isthmus is larger, lies medial to the body of the incus and passes between the stapes and the tensor tympani tendon. The posterior isthmus is small and lies between the medial incudal fold and posterior tympanic wall. The epitympanum is connected to the mastoid antrum by a small triangular bony passage known as aditus ad antrum.

The clinical importance of this tympanic diaphragm is that it resists the spread of epitympanic cholesteatoma to the mesotympanum and vice versa. Also, the patency of the aditus ad antrum and tympanic isthmus is important for aeration of the mastoid.

Mastoid antrum, aditus ad antrum and air cells

Mastoid antrum

The mastoid antrum and its air cells lie within the petrous portion of the temporal bone. The air filled spaces communicate with the middle ear by way of the attic and some small spaces between the suspensory ligaments of ossicles.

The roof of the mastoid antrum and mastoid air cell space forms the floor of the middle cranial fossa, whereas the medial wall relates to the posterior cranial fossa. Just deep to the aural plate of the posterior cranial fossa is the sacculus endolymphaticus, which derives from the

endolymphatic duct, which in turn has passed through the vestibular aqueduct of the temporal bone. There are several straight blood vessels running along the temporal bone. There are several straight blood vessels running along the length of the sac on its mastoid surface. Posterior to the endolymphatic system is the sigmoid sinus, which curves downwards only to turn sharply upwards to pass medial to the facial nerve and then become the dome of the jugular bulb in the middle ear space. The posterior belly of the digastric muscle forms a groove in the base of the mastoid bone. The corresponding ridge inside the mastoid lies lateral not only to the sigmoid sinus, but also to the facial nerve and is a useful landmark for finding the nerve itself. The periosteum of the digastric groove on the undersurface of the mastoid bone continues anteriorly and part of it becomes the endosteum of the stylomastoid foramen and subsequently of the facial nerve canal.

The outerwall of the mastoid lies just below the skin and is easily palpable behind the pinna. Suprameatal triangle (Mac Ewan's triangle) is a direct lateral relation to the mastoid antrum and is formed by a posterior prolongation of the line of the zygomatic arch and a tangent to this that passes through the posterior border of external auditory meatus. The mastoid antrum lies 15mm deep to this triangle.

Aditus ad antrum

It is a narrow communicating passage from the upper attic space of the epitympanum into the mastoid antrum. The horizontal semicircular canal lies between its medial wall and the floor and the short process of incus lies on its floor. The facial nerve lies on a plane below and deep to the opening of the aditus from the attic.

Mastoid process

It lies behind the tympanic portion of the temporal bone and on the deeper aspect behind the styloid process. At birth it is flat and the facial nerve which emerges from the stylomastoid foramen is superficial. The development starts with development of sternocleidomastoid muscle around two years of age, continuing till the end of puberty.

During development the mastoid process excepting the antrum is filled with bone marrow which later, in about 80% of cases, becomes pneumatized resulting in a cellular mastoid. In some cases the bone marrow persists, then it is known as diploic. In a third type the air cells are totally absent, known as acellular or ivory of sclerosed mastoid. The latter two types have relation to cholesteatoma.

The air cells also form in both the petrous and squamous parts of the mastoid and when well developed they may be classified according to the anatomical location into the following groups.

1. Zygomatic – Extending into the root of zygomatic process
2. Tegmen- Spread under tegmen tympani
3. Angle – Sinodural angle
4. Marginal – Behind the sigmoid sinus
5. Perisinus – Over the sigmoid sinus plate
6. Periantral – Close proximity to the antrum
7. Retrofacial – in galleries around the facial nerve or tunneling medial to it to communicate with the middle ear.
8. Perilabyrinthine: Sometimes extending to the petrous apex, perilabyrinthine cells may occur about the arch of the superior semicircular canal (supralabyrinthine); beneath the labyrinthine (infralabyrinthine) or behind it (retrolabyrinthine cells).
9. Tip-Occasionally extending beyond the mastoid tip into the styloid process.
10. Peritubal-Joining the cells in the hypotympanum.

Radiological evidence of pneumatisation is usually not present till the age of three years. The two mastoids are similar except in disease.

Facial nerve

The facial nerve is the nerve of the second branchial arch, which explains its complex and intimate relationship with the middle ear cleft and the ossicular chain. Facial nerve is a mixed nerve containing motor, sensory and parasympathetic fibres.

The facial nerve enters the temporal bone through the porus acousticus and internal auditory canal together with the cochlear nerve, the nervus intermedius and the internal auditory artery and veins, all these structures being ensheathed in a prolongation of the subarachnoid space with its meninges.

At the fundus or lateral extremity of the internal auditory canal the nerve continues with the nervus intermedius, into the bony fallopian canal, which runs laterally above the vestibule (the labyrinthine portion of the facial nerve which is the narrowest part of facial canal, 0.7 mm in diameter at the site of entry) separated from the middle cranial fossa by a thin layer of bone. Upon reaching the medial wall of the epitympanic recess, it bends sharply backwards above the

promontory and arches downwards in the medial wall of the aditus to the tympanic antrum. The point at which it bends sharply backwards is the first genu, at which point it manifests a reddish ganglioform swelling, the geniculate ganglion. In some cases the bony roof of the canal is absent so that ganglion is directly related to the duramater.

From the geniculate ganglion the nerve runs posteriorly and slightly inferiorly in the medial wall of tympanum. Here the bony fallopian canal forms a cylindrical ridge- tympanic course of nerve, lying slightly inferior to the horizontal semicircular canal and superior to the oval window and promontory. The anterior limit of this section of nerve is marked by the processus cochleariformis with its emerging tensor tympani tendon, a valuable landmark.

In the bony floor of the aditus, the nerve makes a gradual bend, the second genu, turning inferiorly 1 or 2 mm behind the pyramid to the commencement of the vertical or mastoid segment. The descending portion of the facial nerve runs directly inferior to the stylomastoid foramen and is surrounded by the mastoid air cells.

Branches of facial nerve

1. Greater superficial petrosal nerve which comes off at the geniculate ganglion.

2. Nerve to stapedius which arises from the facial nerve opposite the pyramidal eminence on the posterior wall of the mesotympanum. It passes forwards through a small canal to reach the stapedius muscles.
3. The chorda tympani nerve- which arises from the facial nerve usually 6mm from the stylomastoid foramen, but the distance is variable and it may be anywhere from 1-2 mm below the nerve to stapedius to the stylomastoid foramen.
4. The posterior auricular nerve supplying the occipitofrontalis and external auricular muscles.
5. The digastric branch to the posterior belly of digastric muscle, and the stylohyoid branch to the stylohyoid muscle all arise close to the stylomastoid foramen.

Finally, the fanwise branching of the facial nerve has five main branches:

Temporal branch

Zygomatic branch

Buccal branch

Mandibular branch

Cervical branch

Venous sinuses of skull

There are four systems of veins that drain blood from the brain and skull. The superficial venous system drains blood from the skin and soft tissue away from the skull and consists of facial, temporal, internal maxillary, posterior auricular and occipital veins. This system leaves via the external jugular vein and to some extent the internal jugular vein also.

A second system of veins drains the blood from the cranial bones and consists of diploic veins.

A third system which is concerned to our subject, complications of CSOM, drains blood from membranes and consists of meningeal veins and venous sinuses of dura matter.

A fourth system drains the blood from brain tissue and consists of cerebral veins.

The last three systems leave the head via the internal jugular vein to a lesser extent via vertebral and external jugular and also through various anastomoses. The second and fourth system go into the venous sinuses before leaving the skull.

APPLIED PHYSIOLOGY

Sound conduction

Sound can be transmitted to the inner ear in one of three ways:

1. By way of the ossicular chain, from the vibrating tympanic membrane to the oval window. This is the most important route.
2. Directly across the middle ear, when waves fall on the round window membrane. This may occur when there is a large perforation of the drumhead.
3. By bone conduction, sound energy is taken up and transmitted to the inner ear through the bones of the skull.

Effective functioning of tympanic membrane and ossicular chain is necessary to conduct sound energy selectively to oval window. They also help to overcome the impedance mismatch between the air and cochlear fluid. The most important factor for efficient impedance transfer mechanism is the difference in the area of tympanic membrane to that of oval window. The effective ratio of these areas is about 14:1. The ossicles themselves constitute a lever mechanism (acting through the rotational axis of malleus and incus) which has a mechanical

advantage of 1.3:1. The product of these areal and lever ratios (14 and 1.3) is about 18:1, which represents the transformer ratio of the whole mechanism. By this effect the amplitude of vibration at the stapes is reduced as compared with that of the membrane, while the force exerted by the stapes upon the labyrinthine fluids is increased in same proportion.

The directly measured values of tympanic membrane impedance suggest that some 68% of the incident energy would be absorbed by the cochlea, as against 1% expected in the absence of middle ear transformer. Tensor tympani and stapedius muscle helps in regulation of sound pressure applied at oval window, thus protecting the cochlea from excessively loud sound.

A perforation in the tympanic membrane, describes the resistance offered to the traveling sound wave. Even a small perforation in the posterior part of tympanic membrane can hamper the perception of sound, by reducing the 'baffle' effect of round window, when acoustic separation of this window is lost. Impairment of conductive function of middle ear can occur due to underlying middle ear pathology such as mucosal edema, fluids, granulation, cholesteatoma, osteitis and ossicular necrosis.

A cholesteatoma mass or granulations can bridge the necrosed ossicles and increase the sound conduction too. Sensory neural hearing loss can occur in CSOM probably because of diffusion of toxins from inflammation into scala tympani via round window membrane or serous labyrinthitis. Recent studies indicate that the pathology is confined to the basal turn of cochlea.

Pressure equalization

The middle ear in health should contain air at atmospheric pressure, which is achieved by a normally functioning Eustachian tube. The Eustachian tube allows the passage of air inside the middle ear by contracting the levator palati muscle, thus dilating the pharyngeal opening and the tensor palati muscle opening the cartilagenous tube during swallowing. The Eustachian tube also allows the secretions of the middle ear to pass onto nasopharynx and also prevents pharyngeal secretions from entering the middle ear by the action of cilia. Interference of this basic function of the tube in equalization of air pressure may arise from intrinsic or extrinsic causes which affects both the normal physiology of sound conduction and resistance to infection. The Eustachian tube function is deficient in 1/3 of chronically infected ears with cholesteatoma.

When the middle ear is cut off from the atmosphere by blockage of tube, absorption of air initially leads to retraction of tympanic membrane, and further absorption of air promotes exudation from the blood and lymphatic vessels of the mucoperiosteum. This secretion is a ready culture medium for bacteria if the tube obstruction is of long standing, fibrotic changes in the tympanic membrane and the ossicular joint may cause fixation of the membrane. Though the middle ear mucosa is not less effective in controlling middle ear infection than the respiratory epithelium, a malfunctioning Eustachian tube makes it impossible to function normally. Even when the infection is cured, the hypertrophied glands in the middle ear can cause continued otorrhoea, making the ear wet and prone to recurrent infection. A long standing negative middle ear pressure can cause thinning of the tympanic membrane making it more prone for perforation.

Vestibular system

The vestibular sense organ contains three semi-circular canals, the utricle and saccule. Hair cells in the ampulla of canals sense the rotational acceleration of the head in three mutually perpendicular planes. The macular receptors in utricle and saccule sense linear

acceleration and static head position in gravitational field. This sensory information is analysed by the brain for balancing the body.

When there is bony dehiscence and the perilymph is only separated by mucosa, spontaneous vertigo occurs. When the labyrinth is invaded by bacteria, a total and permanent loss of vestibular and auditory function of that ear will result, with distressing episodes of vertigo lasting several days, unless treatment is initiated very early in the course of invasion of bacteria. When complete labyrinthine loss in one ear occurs, compensation occurs due to relearning by the other vestibular apparatus and within a few weeks the patient no longer experience vertigo.

Immunology

The role of immune system in middle ear disease has received a considerable amount of attention in the recent years. In essence, the reaction of middle ear to disease process is highly involved with immune response including the immunoglobulins, complement system and the cellular reaction which includes migration factors.

Normally Langerhan's cells are present only in the suprabasal portion of the epithelium, however in the cholesteatoma matrix the Langerhan's cells are situated at various levels within the epithelium.

It is believed that Langerhan's cells are able to bind antigens and present them to lymphocytes either in the epithelium or regional lymph nodes. It appears that the Langerhan's cells are able to initiate an immunological response in the presence of antigen, the end product being an inflammatory reaction to its subsequent bone destruction.

As in any part of the body, in the middle ear too, specific antibodies are produced against the chronically infecting organisms. The persistence of organisms in middle ear, even in the presence of specific antibodies is noteworthy.

GENERAL CONSIDERATIONS OF CSOM

Chronic suppurative otitis media is defined as “an inflammatory process within the middle ear cleft associated with irreversible tissue pathology. It may be active with continuous suppuration or inactive with sequelae of a burnt out infection”.

The disease nearly always is associated with a tympanic membrane perforation and may be active when infection and otorrhea are present, or quiescent when they are absent. The length of active and quiescent periods varies from patient to patient. Individuals prone to upper respiratory infections and allergies tend to experience more frequent and lengthier episodes of active disease.

Complications of otitis media

Temporal bone

Middle ear

- i) Facial nerve paralysis
- ii) Ossicular lesions
- iii) Perforation of the tympanic membrane

Extra temporal

Intracranial

- i) Extradural abscess
- ii) Subdural abscess
- iii) Brain abscess
- iv) Meningitis

v) Lateral sinus

thrombophlebitis

vi) Otitis hydrocephalus

Mastoid

i) Petrositis

ii) Reduced pneumatisation

iii) Coalescent mastoiditis

Extracranial

i) Bezold's abscess

ii) Zygomatic abscess

iii) Postauricular abscess

Inner ear

i) Labyrinthitis

ii) Sensorineural hearing loss

Others

Developmental

Behavioural

Extracranial complications of otitis media

Extra temporal- Bezold's abscess, Subperiosteal abscess

Intratemporal- Mastoiditis, Labyrinthitis, Sensorineural hearing loss, Petrous apicitis (petrositis), Facial paralysis, Cholesteatoma, Labyrinthine fistula.

The following classification combines Mawson, Schuknecht and Gail Meely.

Aural complications

- i) Mastoiditis
- ii) Mastoid abscesses
- iii) Sub-periosteal abscess
- iv) Bezold's abscess
- v) Zygomatic abscess
- vi) Luc's abscess
- vii) Citelli's abscess
- viii) Pharyngeal abscess
- ix) Petrositis
- x) Labyrinthitis
- xi) Facial nerve palsy
- xii) Osteomyelitis of temporal bone

Role of cholesteatoma in development of complications

Majority of the complications of CSOM are due to bone erosion. Clinical evidence has shown that presence of cholesteatoma enhances the process of bone erosion.

Cholesteatoma may be defined as the presence within the middle ear cleft of a squamous epithelial packet or sac filled with keratin debris. Three types are recognized.

1. Congenital cholesteatoma

This is an epithelial cyst occurring within one of the bones of the skull (usually the temporal bone) without contact with the external ear. It may occur deep in the temporal bone or in the squama.

2. Primary acquired cholesteatoma

This type of cholesteatoma develops in continuity with the perforation of the pars flaccida of the tympanic membrane. It first fills the Prussack's space and then may enlarge to occupy the attic, mastoid antrum and portions of the middle ear.

3. Secondary acquired cholesteatoma

Usually follows active middle ear infection where the keratinizing epithelium has migrated through a perforation into the middle ear.

Many theories have been proposed, but none as yet has been shown to be entirely causative in this disease. Among the postulates are:

1. Habermann (1889) demonstrated that migration of stratified squamous epithelium from the skin of the meatus through a perforation into the middle ear led to the subsequent development of a secondary acquired keratoma.
2. Bezold (1908) stated that attic retraction type of keratoma was due to Eustachian tube occlusion causing retraction of Sharpnel's membrane into Prussak's space and later into the attic.
3. Wittmack (1933) has shown that persistence of hyperplastic embryonic mucoperiosteum in the attic might cause adhesions to form retraction pockets as the retraction pocket deepens, desquamated keratin cannot be cleared from the recess and cholestatoma results.

4. Ruedi (1963) reported two predisposing factors for the development of acquired keratoma.
 - i) The special growth potential of the basal cells in the stratum germinatum in the circumscribed zone of the meatal skin adjoining the upper margin of the tympanic membrane.
 - ii) Submucous connective tissue layer in the middle ear spaces associated with incomplete pneumatisation of the preformed spaces.
5. Wendt (1873) theorized that the simple squamous or cuboidal epithelium of the middle ear cleft could undergo a metaplastic transformation into keratinizing epithelium.

Sade (1971) supported that theory, pointing out that epithelial cells are pluripotent and can be stimulated by inflammation to become keratinizing.

Although the exact mechanism of bone erosion by cholesteatoma is debatable, many theories are postulated.

Chole (1984) has shown evidence that bone resorption is primarily due to action of multinucleated osteoclasts on bone. Although many mononuclear cells (histocytes and fibroblasts) were present in the vicinity of active bone resorption, only multinucleated

osteoclasts were seen to disrupt the lamina limitans of bone and cause resorption lacunae.

In order for bone resorption to occur, enzymatic removal of the organic and inorganic components must occur. It is likely that these enzymes are elaborated or activated by the resorbing cells (osteoclasts) in their immediate micro – environment. These enzymes include acid phosphatase, collagenase and acid proteases.

Guasa et al. (1978) demonstrated that the pH of keratin debris within cholesteatoma was acidic which might lead to demineralization of the hydroxyapatite of bone.

Moriyama et al (1984) have shown that keratin itself may induce an inflammatory reaction which leads to local bone resorption.

The physical effects (pressure) of cholesteatoma may lead to transient electrical potentials and the recruitment of monocytes into the subepithelial spaces. These monocytes may activate the cellular events of bone resorption. Activated monocytes can produce prostaglandin E_2 which is a stimulator of bone remodeling. Other osteoclastic activating factors, such as interleukin 1α and 1β and TNF α and β may be produced, which then lead to localized osteoclastic activity.

Role of granulation tissue

Granulation tissue is the natural result of epithelial ulceration and is directly proportional to the persistence of infection. Granulation tissue, believed by some to be atleast more prevalent if not more significant than cholesteatoma, in the natural bulk impairs drainage and its enzymatic production erodes bone. Formation of granulation tissue is a host defence mechanism in response to inflammation. Granulation also forms in response to the presence of cholesterol crystals formed from blood clot and also from oily drops and chloramphenicol applied as medication. It is a proliferation of fibrous and vascular tissue. These capillaries are surrounded by pericycles, some of which transform into histocytes. Histocytes predominate in the zone close to bone and this zone is shown to have marked acid phosphatase activity associated with bone resorption. With maturation, granulation tissue becomes more dense with increased collagen and reticular formation. It is self perpetuating in that it reduces the effectiveness of medical therapy and ventilation of middle ear.

DEFINITIONS AND CLASSIFICATIONS OF MASTOIDECTOMY

Atticotomy (Epitympanotomy)

Atticotomy denotes opening of the attic, performed through the trans meatal route. The lateral wall of the attic is drilled away and the lateral attic is exposed. This can be performed in several ways resulting in various modifications:

- Preservation of the bony bridge by drilling superior to the bony annulus and widening it towards the tegmen tympani
- Total removal of the bony bridge together with the lateral attic wall upto the tegmen tympani, exposing the lateral attic, the ossicles and the ligaments.
- Partial removal of the bony bridge. This situation can be caused by spontaneous resorption of the bony annulus by cholesteatoma.
- Displacement of the intact bridge in cases with attic cholesteatoma and spontaneous resorption of the bridge or in cases requiring drilling of the bony annulus in order to provide better exposure of the mesotympanum.

Atticoantrotomy

Atticoantrotomy is an extension of the atticotomy in a posterior direction through the transmeatal route. The lateral attic and the aditus walls are removed and the antrum is entered. The posterosuperior bony ear canal wall is removed and the access to the antrum is gradually widened.

Bondy's Operation

An atticoantrotomy is described as Bondy's operation if the tympanic cavity is not entered. The lateral part of the cholesteatoma matrix removed and the medial part is left in place marsupializing the cholesteatoma.

Cortical Mastoidectomy

The cortical mastoidectomy (Schwartz 1873) is a transcortical opening of the mastoid cells and the antrum. It is the initial stage of any transmastoid surgery of the middle ear, inner ear, facial nerve, endolymphatic sac, labyrinth, internal auditory canal and the various procedures on the skull base for removing skull base tumours. The term *simple mastoidectomy* is usually used for drainage of a mastoid abscess. The bony meatal wall remains intact and is relatively thick medially. The anterior attic in simple mastoidectomy is not exposed

and only the superior aspects of the malleus head and incus body as well as the prominence of the lateral semicircular canal are visualised. The cavity walls are usually not polished and the mucosa is widely preserved.

Approaches and Routes

The two most frequently used approaches are the retroauricular and endaural ones and the common routes are the transcortical and transmeatal.

Endaural approach

In this approach the instruments pass through the introitus and the lateral part of the external auditory meatus, which can either remain intact during the surgery, but has to be stretched by an ear speculum or can be more or less widened using various incisions.

Retroauricular approach

The incision is made behind the auricle, which is pulled anteriorly and the surgery takes place initially behind the auricle and behind the auditory meatus. The exposure is generally wider than in the endaural approach and it can easily be further widened in ears with

large air cell systems or in ears with complications requiring extensive surgery.

Transcortical route (outside-in route)

The transcortical route for drilling starts on the surface of the cortical bone of the mastoid process behind the bony ear canal which can remain intact either temporarily or permanently.

Transmeatal route(inside-out route)

The transmeatal(transcanal) route for drilling starts in the bone of the ear canal, either laterally or medially.

Canal wall up and canal wall down mastoidectomies

Mastoidectomies are classified exclusively on the basis of whether the posterior canal wall is removed or remains intact. The fact that the bony ear canal wall sometimes remains only partly intact, eg.after spontaneous erosion or is deliberately partly removed, results in several modifications of the canal wall mastoidectomy techniques.

Subclassification of or synonyms for canal wall down mastoidectomy techniques are:

Atticotomy, Bondy's operation, atticoantrostomy, classical radical operation, retrograde mastoidectomy and several variations of

intact bridge techniques by Paparella and Jung. Paparella method is an open canal wall down method, the Wigand method called tympanomeatoplasty with preservation of the bony bridge is mainly a canal wall up closed technique with repneumatisation.

Subclassification of canal wall up techniques is:

Simple mastoidectomy, cortical mastoidectomy, classic intact canal wall mastoidectomy, combined approach tympanoplasty or modifications of these canal wall up techniques.

Open technique:

In canal wall down mastoidectomy, the cavity may remain open, neither obliterated nor with the ear canal reconstructed. The exposed bone is either simply covered with fascia or skin or not covered at all. This type of cavity is lined by granulations and later reepithelialised.

Closed technique:

The canal wall down mastoidectomy cavity can be partly or totally obliterated or the ear canal partly or totally reconstructed. A partial obliteration of the mastoid tip alone is defined as an open technique. The canal wall up mastoidectomy cavity can be totally or partially obliterated behind the intact bony ear canal or it can be

repneumatised in the hope that the cavity will fill with air and remain ventilated. Both these principles are closed techniques.

Classic canal wall up mastoidectomy:

Canal wall up mastoidectomy also described as the classic intact canal wall mastoidectomy or combined approach tympanoplasty is defined as a mastoidectomy with an entirely preserved, but thinned out bony ear canal wall. The disease in the attic is removed through careful drilling of all the bone between the ear canal and the tegmen tympani and hence enlarging access to the attic. Access to the tympanic cavity is achieved by a so called posterior tympanotomy. The goal of intact canal wall mastoidectomy is to repneumatise the mastoid cavity.

Modifications of intact canal wall mastoidectomy

1. Atticotomy with preservation of the intact bony bridge.
2. Atticotomy with preservation of a partly resorbed bony bridge.
3. Atticotomy with removal of the bridge.
4. Widening of the ear canal.

Canal wall down mastoidectomy

This is defined as removal the posterior bony canal wall thus making the entire mastoid antrum and the middle ear into a single

cavity. There are several modifications depending on the preservation or partial preservation of the bony bridge, resulting in *intact bridge techniques*. In cases with resorption of the lateral attic wall, the bridge can be preserved, but it is displaced laterally and posteriorly. The bridge may be partly resorbed or surgically removed either anteriorly or posteriorly. In combination with various degrees of ossicular deficiency and various types of partial bridge removal, several variations are described.

MATERIALS AND METHOD

32 patients who attended ENT Department, Govt Rajaji Hospital, Madurai from June 2007 to September 2009 were included in this study.

The diagnosis of chronic suppurative otitis media – atticofacial pathology with or without cholesteatoma or granulations was made on clinical grounds.

SELECTION CRITERIA:

- Chronic suppurative otitis media
- Atticofacial pathology – retraction or perforation
- Posterosuperior marginal pathology – retraction / perforation
- Cholesteatoma or granulations.
- Secondary acquired cholesteatoma.

EXCLUSION CRITERIA:

- Age less than 5 years.
- Age above 40 years.
- Pregnant and lactating women
- CSOM- Tubotympanic type.
- CSOM with intracranial complications.

All patients were explained about the disease and the benefits and side effects of the procedure. Informed written consent was obtained before the initiation of the study.

All patients were evaluated as follows:

1. History.
2. General examination
3. Systemic examination
4. Otorhinolaryngological examination
5. Investigations
 - Complete hemogram
 - Urine analysis
 - Blood sugar, urea, serum creatinine
 - Aural swab culture & sensitivity
 - X-ray both mastoids
 - Pure tone audiogram
 - CT- temporal bones.
6. Assessment of the patient under general anaesthesia.

SURGICAL PROTOCOL AND METHODOLOGY

Mastoid cortex exposed and drilled. Cholesteatoma removed and disease clearance given with canal wall up mastoidectomy in 13 cases and with canal wall down mastoidectomy in the rest 19 cases. Post operatively the patients were treated with appropriate antibiotics, analgesic antiinflammatory drugs and decongestants. Patients were discharged one week postoperatively.

FOLLOW UP:

- Mastoid cavity pack removal on post op day 2.
- Post auricular wound suture removal on post op day 7.
- External auditory canal pack removal on post op day 21.
- Oral antibiotics for 21 days.
- Antihistaminics for one month.
- Antibiotic drops for 2 months.
- Monthly once follow up for a period of 6 months.

POST OP RESULT ASSESSMENT:

1. Symptoms:

*discharge from operated ear.

*hearing improvement.

2. Clinical findings.

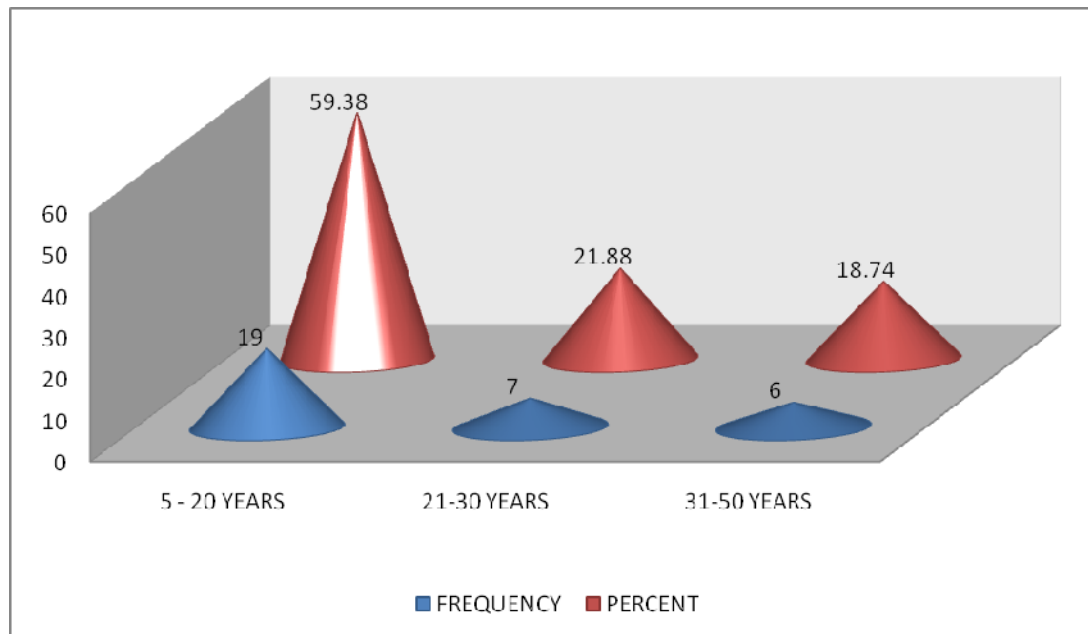
3. Otoendoscopic finding.

4. Pure tone audiogram at the end of third month post operatively.

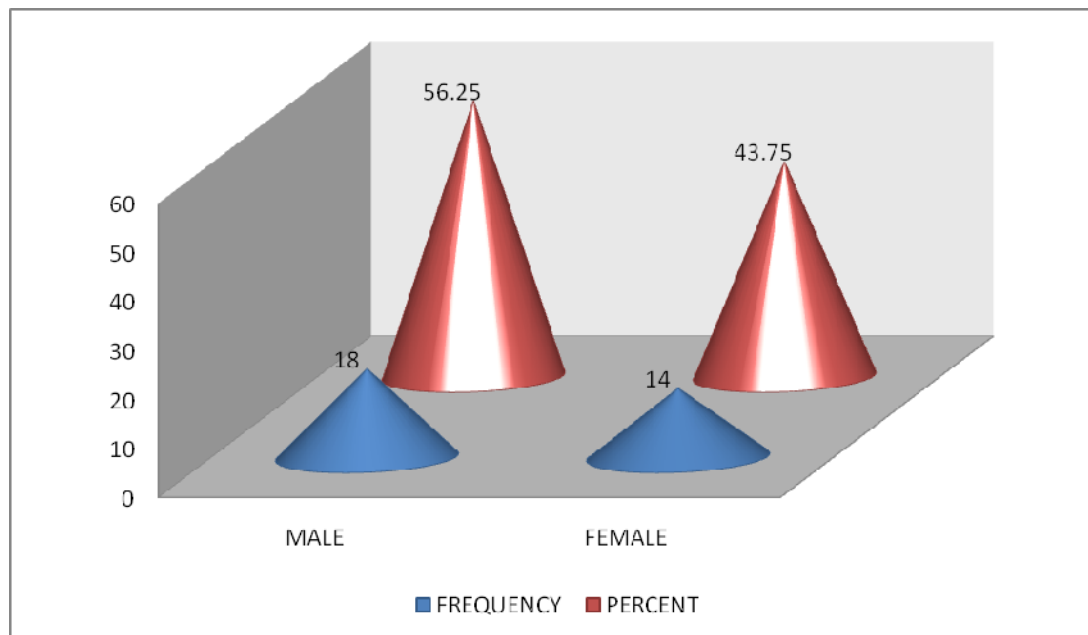
The patients were divided into two groups- group 1 consisting of 13 patients who were operated by canal wall up technique and group 2 consisting of 19 patients who were operated by canal wall down technique. The data so collected was analysed and the same discussed here.

ANALYSIS OF RESULTS

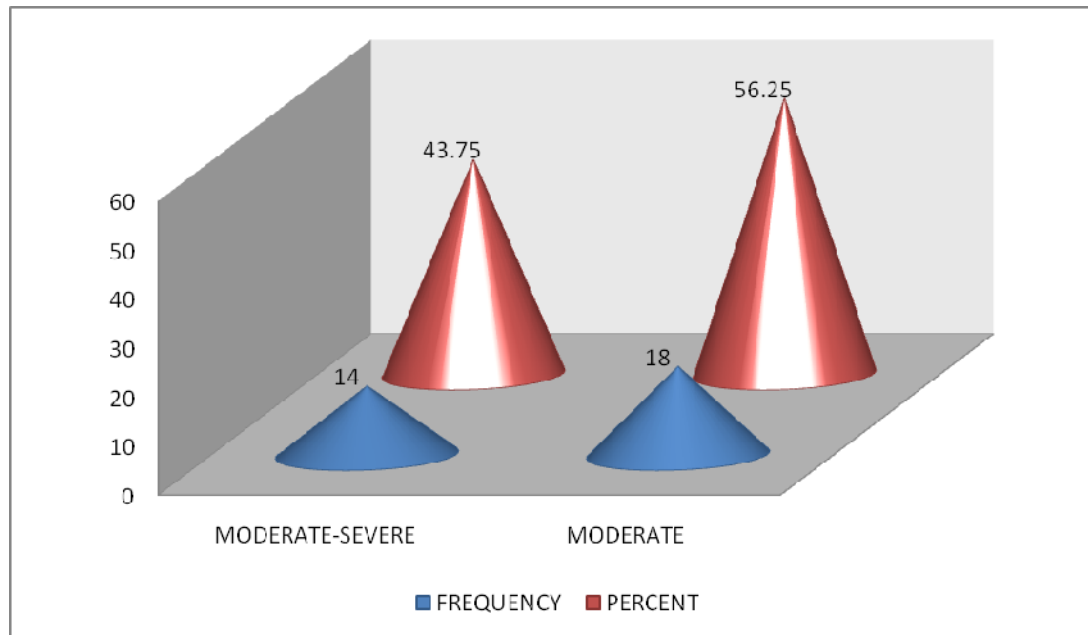
AGE PROFILE OF THE PATIENTS



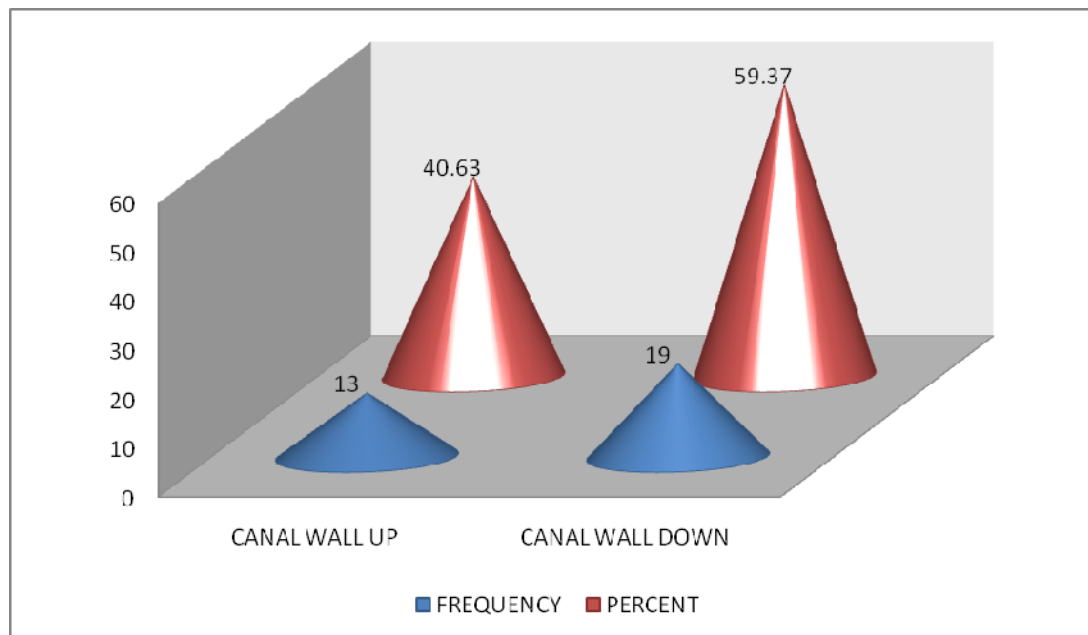
SEX OF THE PATIENTS



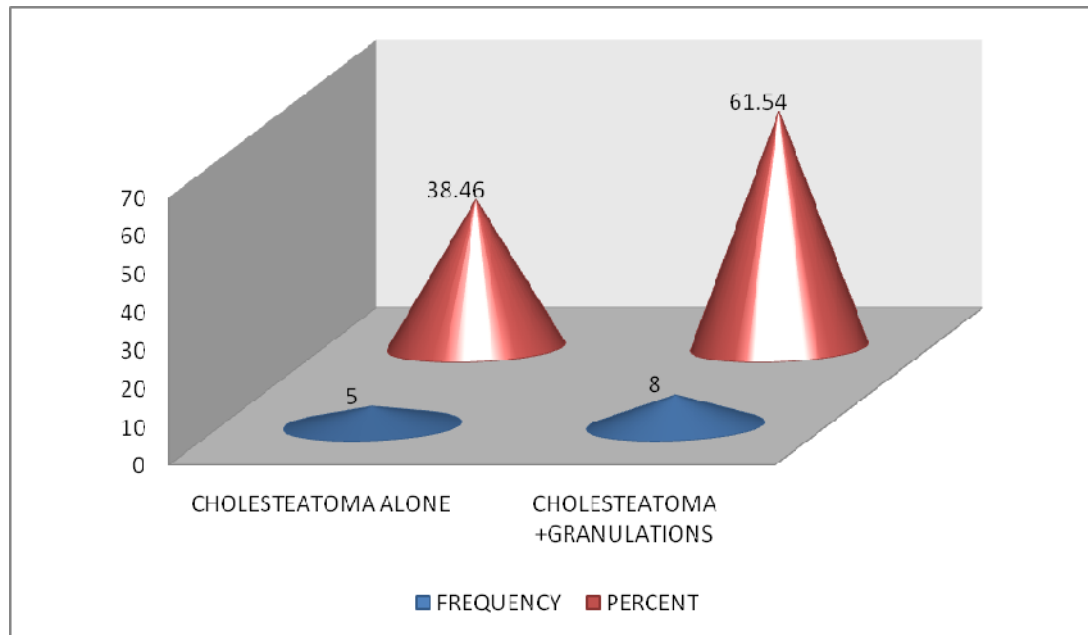
PRE OPERATIVE HEARING LOSS



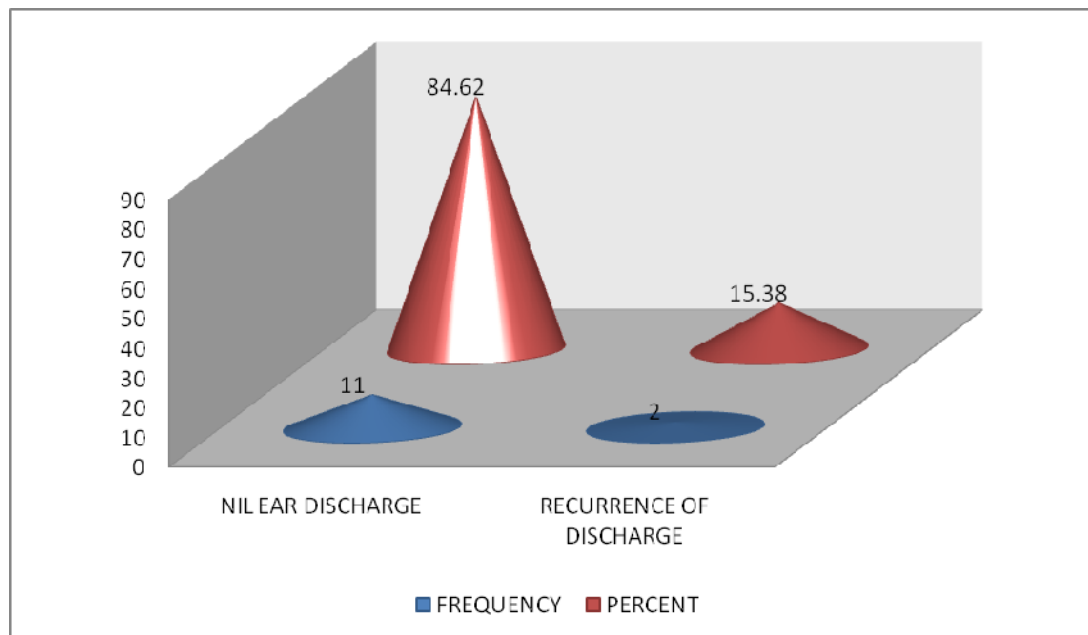
TYPE OF SURGERY



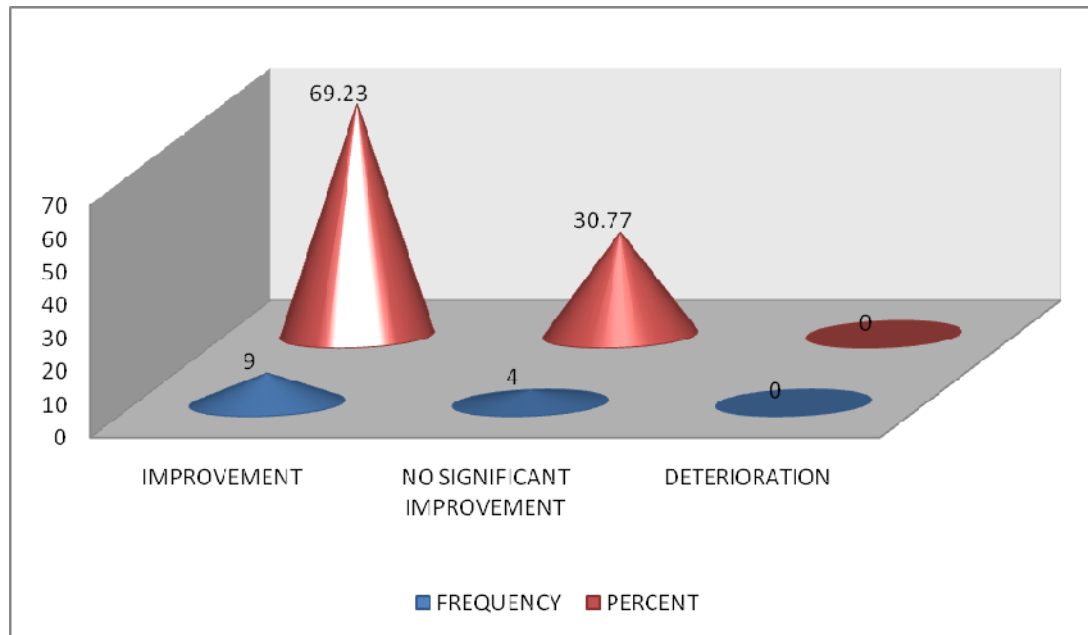
PER OPERATIVE FINDING IN GROUP 1 PATIENTS



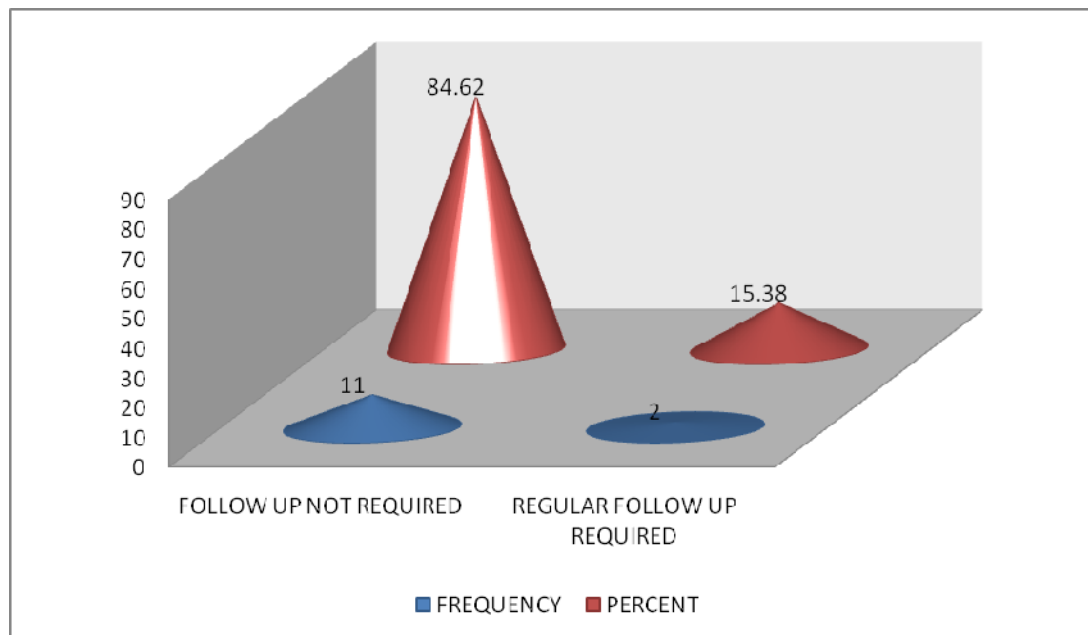
POST OPERATIVE EAR DISCHARGE IN GROUP 1 PATIENTS



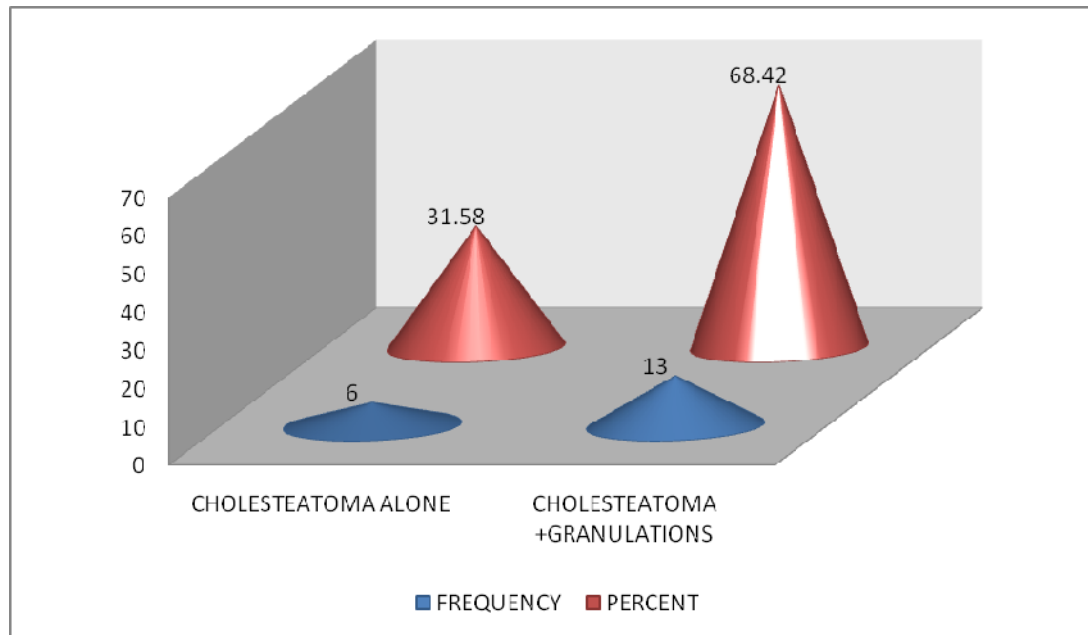
POST OPERATIVE HEARING IN GROUP 1 PATIENTS



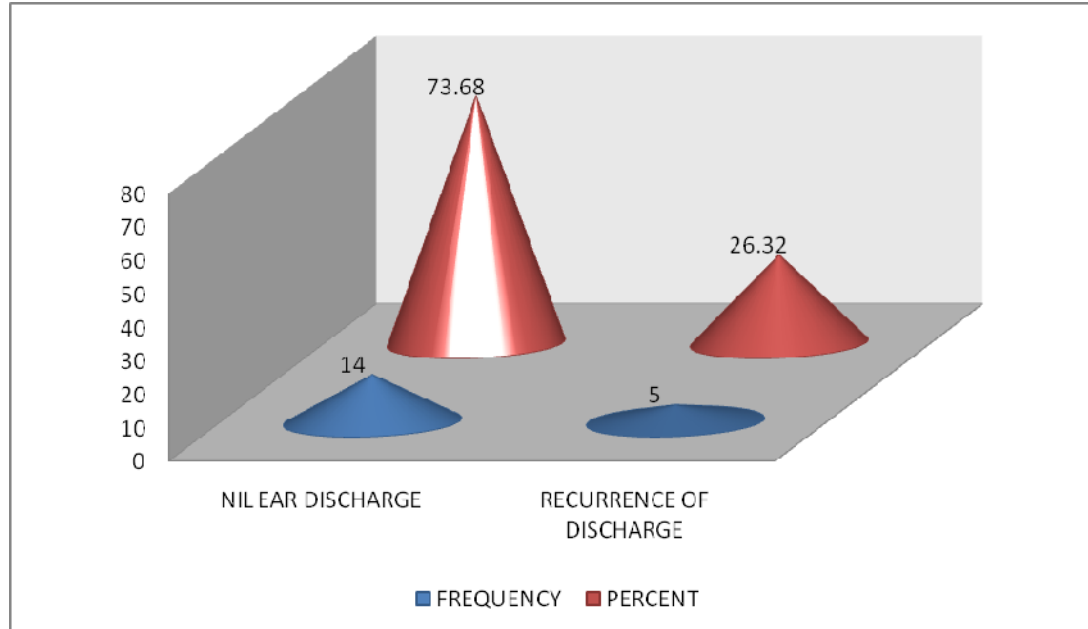
REQUIREMENT OF FOLLOW UP IN GROUP 1 PATIENTS



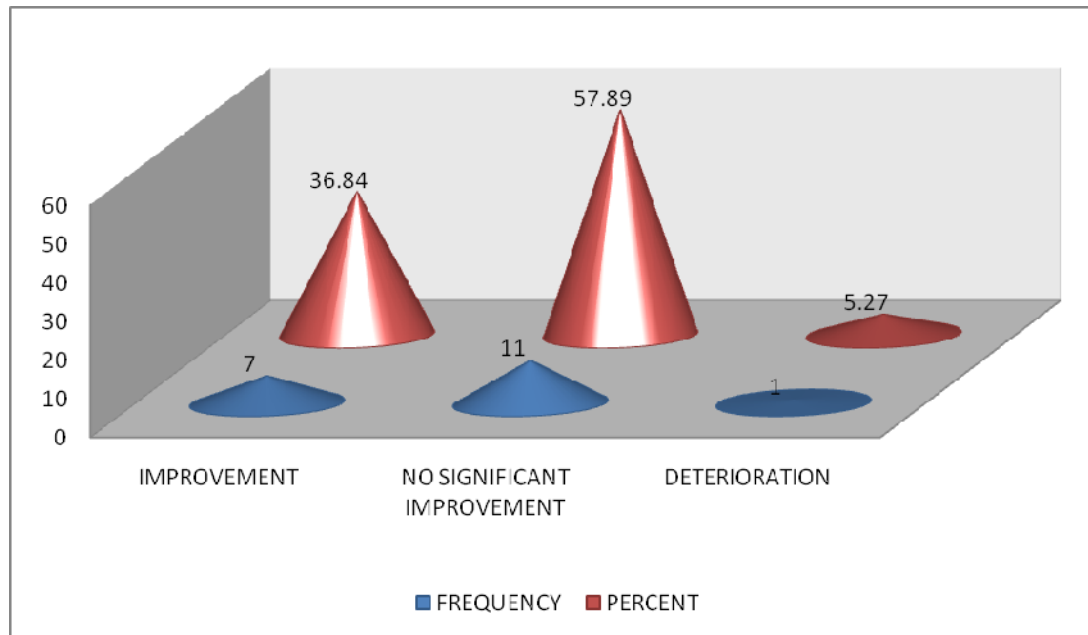
PER OPERATIVE FINDING IN GROUP 2 PATIENTS



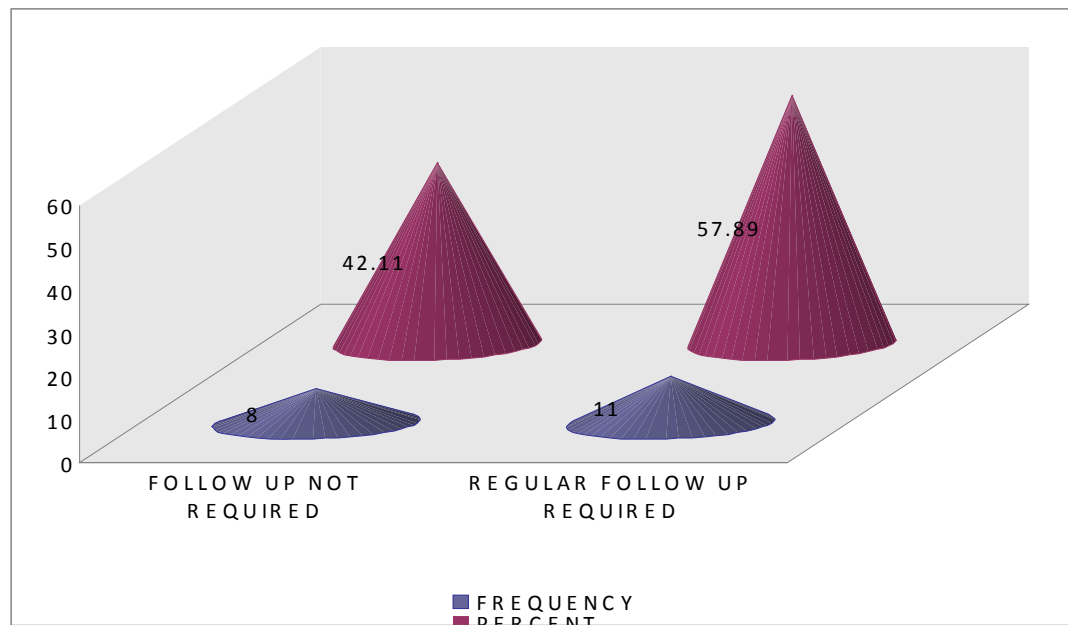
POST OPERATIVE EAR DISCHARGE IN GROUP 2 PATIENTS



POST OPERATIVE HEARING IN GROUP 2 PATIENTS



REQUIREMENT OF FOLLOW UP IN GROUP 2 PATIENTS



DISCUSSION

A similar study titled “Canal wall down mastoidectomy: A long term commitment to the outpatients?” was conducted by Hisham S Khalil and Paul C Windle-Taylor, Department of Otolaryngology, Head and Neck Surgery, Derriford Hospital, Plymouth, Devon, U.K and published in the Journal List of BMC Ear Nose Throat Disorders, v.3; 2003 and concluded that Canal Wall Down Mastoidectomy carries an intrinsic morbidity resulting in a long term attendance in the outpatients.

The results of this study can be compared with ours which are as follows:

Results of group 1 patients (canal wall up mastoidectomy):

About 85% of cases did not have any post operative discharge and only about 15% of cases had post operative ear discharge. About 69% of cases had improvement in hearing post operatively and 31% had no significant improvement and nil patients had deterioration of hearing. About 85% did not require any long term follow up whereas 15% required regular follow up post operatively.

Results of group 2 patients (canal wall down mastoidectomy):

About 74% of cases did not have any ear discharge post operatively and 26% had recurrence of ear discharge. About 37% of cases had improvement in hearing post operatively, 58% had no significant improvement in hearing and 5% had deterioration of hearing. About 68% did not require any long term follow up and 32% required regular follow up post operatively.

By Chi-Square test, with regards to post operative recurrence of ear discharge in both groups of patients, p value is <0.1 and is found to be not significant.

With regards to post operative improvement of hearing in both groups of patients, p value is found to be <0.05 and is found to be significant.

With regards to requirement of follow up in both groups of patients, p value is <0.01 and is found to be significant proving that canal wall up mastoidectomy is better than canal wall down procedure.

CONCLUSION

This study “**A DISSERTATION ON COMPARISON OF THE RESULTS OF OUTCOME OF CANAL WALL UP MASTOIDECTOMY AND CANAL WALL DOWN MASTOIDECTOMY FOR CHRONIC SUPPURATIVE OTITIS MEDIA**” was conducted in the Department of ENT, Government Rajaji Hospital, Madurai during the period of September 2008 to December 2009.

This study consists of detailed history, preoperative investigations, surgery, postoperative follow up and evaluation and statistical analysis of data.

- Total number of 32 cases of chronic suppurative otitis media with limited atticoantral pathology were surgically treated and evaluated.
- Goals of surgical management of CSOM are eradication of disease, restoration of hearing and to an extent possible maintenance or restoration of a normal anatomical configuration.

- In intact canal wall mastoidectomy , since the posterior canal wall is maintained, there is significant improvement in hearing post operatively.
- In addition there are nil cavity problems. Regular follow up for cavity cleaning is not required.
- In canal wall down mastoidectomy, a large cavity is created after rendering disease clearance and post operative improvement in hearing is less when compared with canal wall up procedures. Also there is post operative cavity problem which necessitates long term follow up of the patients.
- The decision to treat chronic suppurative otitis media by surgery, in this case by a canal wall down procedure, is not to be undertaken lightly. Whatever the reason for the procedure, the patient will become a regular visitor to the outpatient for many years to come, and will only be discharged if the cavity is entirely trouble-free and self-cleaning over a number of consecutive visits.

FIG.1 RELATIONS OF MIDDLE EAR CAVITY

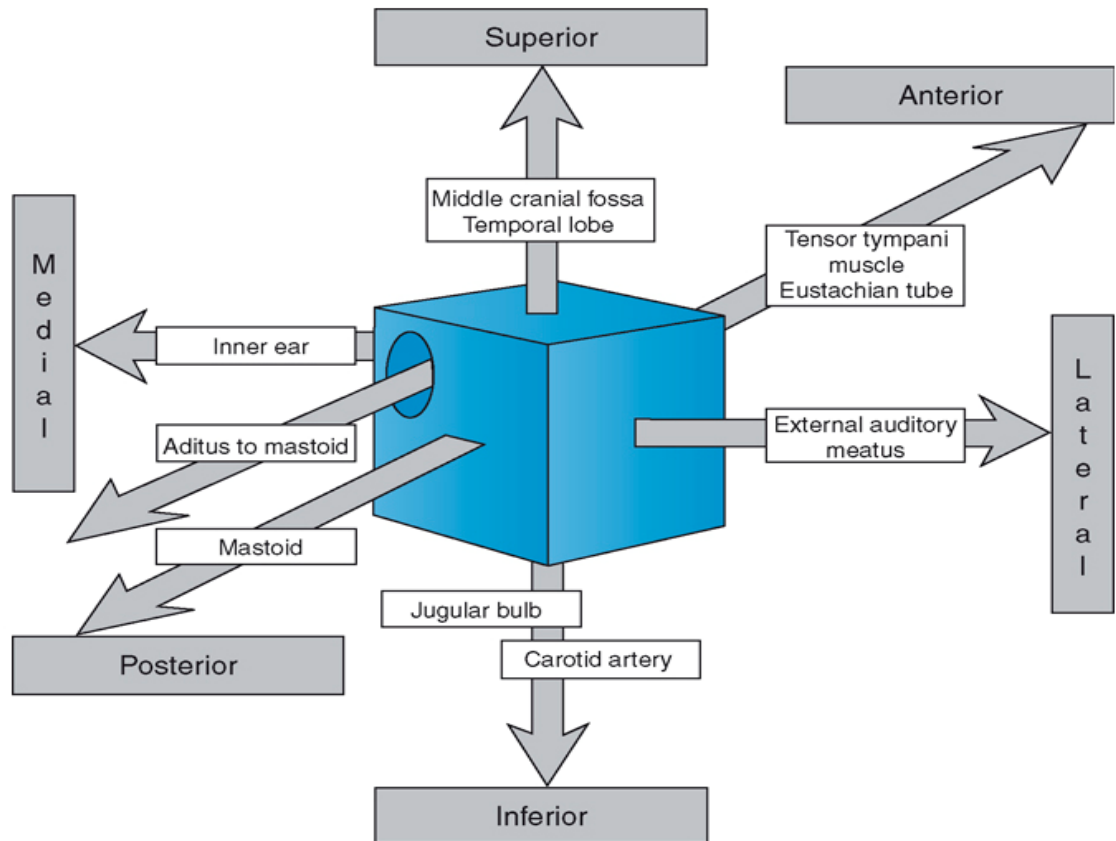
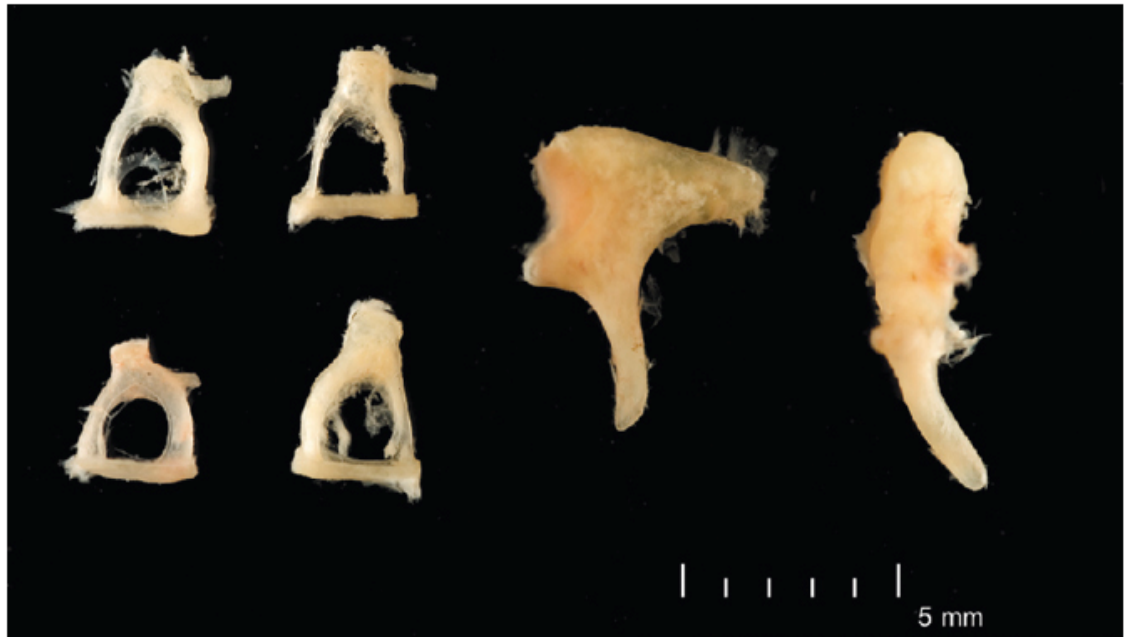


FIG. 2. OSSICLES



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FIG. 3. MUCOSAL FOLDS OF MIDDLE EAR

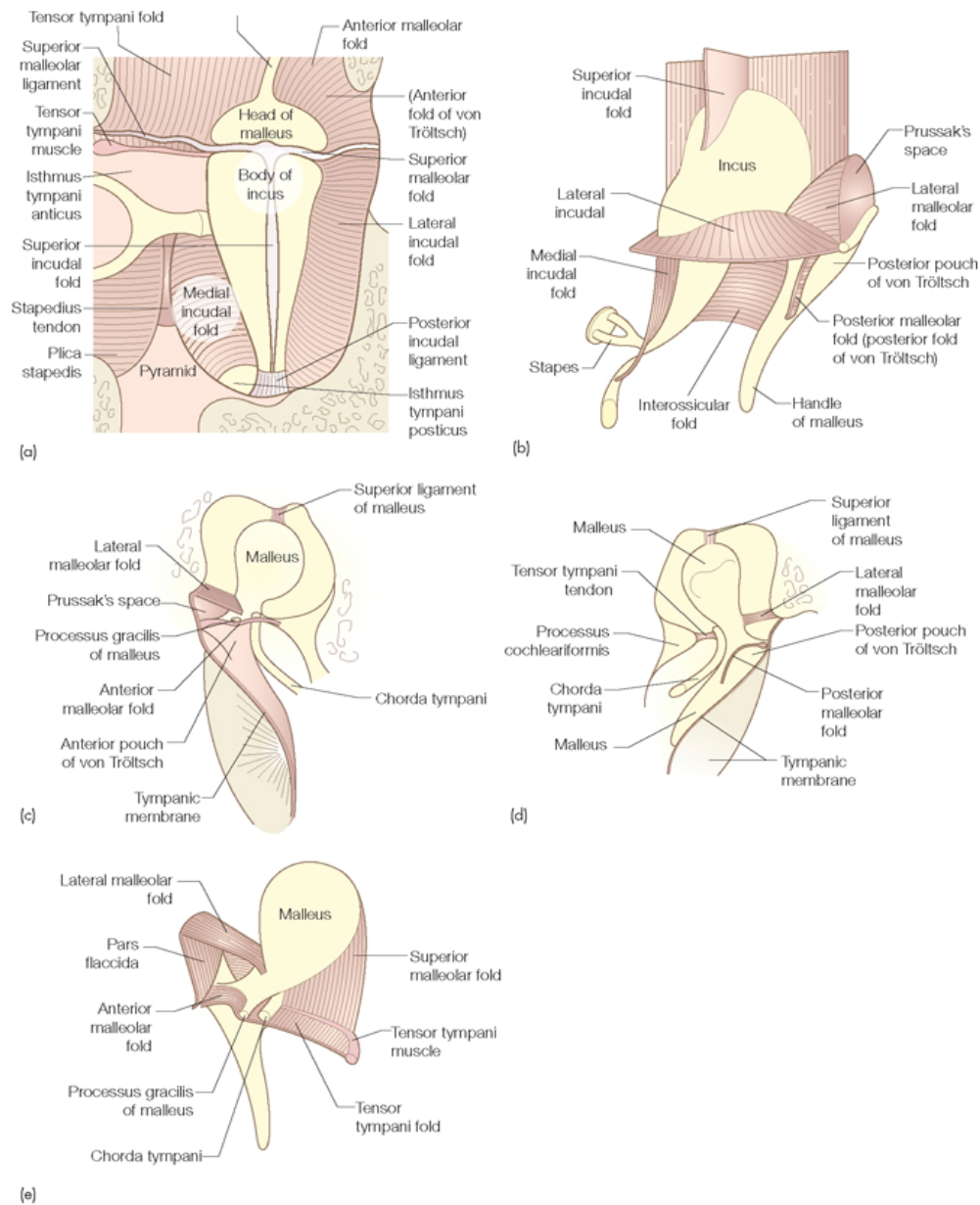
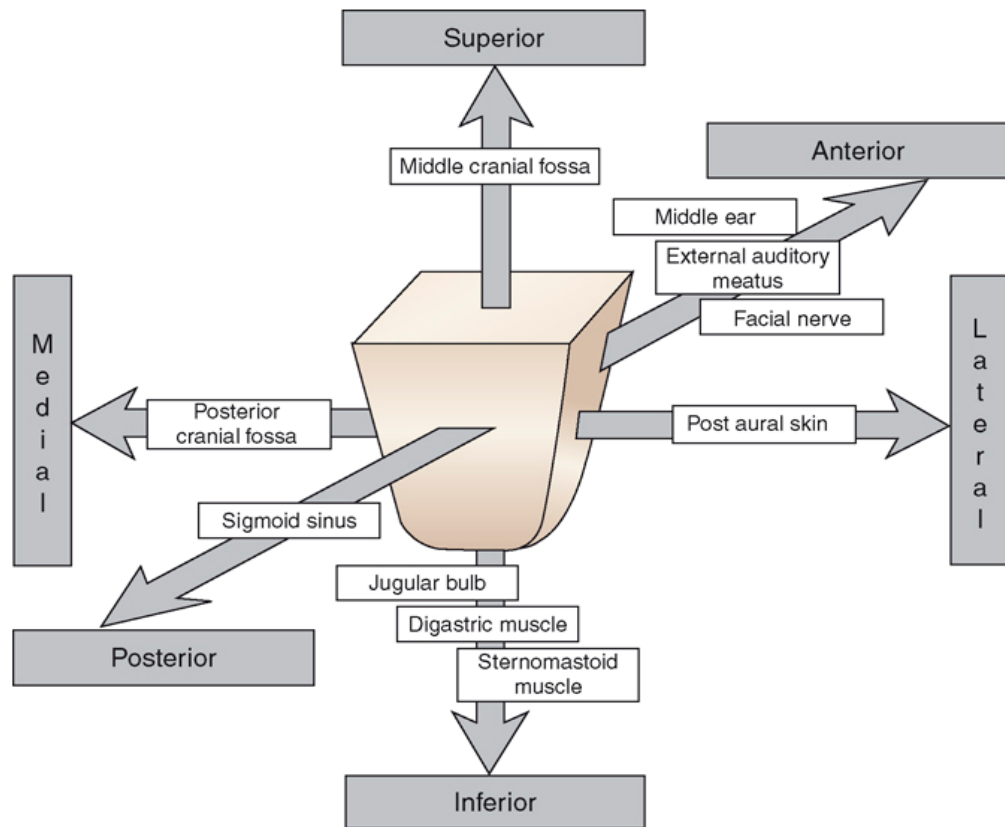


FIG 4: RELATIONS OF MASTOID ANTRUM



DISSERTATION - PROFORMA

COMPARISON OF THE RESULTS OF OUTCOME OF CANAL WALL UP MASTOIDECTOMY AND CANAL WALL DOWN MASTOIDECTOMY FOR CHRONIC SUPPURATIVE OTITIS MEDIA.

PATIENT DETAILS : [PATIENT NO: _____]

NAME :

AGE / SEX :

ADDRESS :

CONTACT NO. :

OCCUPATION :

D OA/ IP NO. :

HISTORY :

PRESENTING COMPLAINTS:-

1) Ear discharge :- Side

Onset

Duration

Amount

Type of discharge

Aggravating / relieving factors

Response to treatment

2) Hard of hearing :- Side

Acute / insidious

Nature – mild / Mod / Mod-Sev / Profound

Progressive / continuous /intermittent

Whether handicapping for him - Y / N

Family History - + / -

H/o trauma to ear

H/o exposure to loud noise

3) Ear ache :- Side

Onset

Progressive / stationary

Continuous / intermittent

Nature of pain

Aggravating / relieving factors

4) Vertigo:- Onset

Duration

Associated nausea / Vomiting

5) Tinnitus

6) Fever

7) Head ache

8) Facial weakness

❖ **Relevant Past History:-**

GENERAL EXAMINATION

GC --

CVS --

RS --

EXAMINATION OF EAR:-

Right

Left

1. Preauricular area

2. Pinna

3. Postauricular

4. Ext. auditory canal

5. Tympanic Membrane

Colour

Lustre

Retraction

Perforation

- Size
- Quadrant

Cholesteatoma

Others

6. Mastoid tenderness

7. Tragal tenderness

8. Fistula test

9. Facial.N testing

10. Tuning fork test

Rinne

Weber

ABC

11. Romberg's sign

EXAMINATION OF NOSE, ORAL CAVITY & OROPHARYNX:-

DIAGNOSIS:

Chronic Suppurative Otitis Media:-

Ear

Type _____

_____ Stage

_____ hearing loss

Complications

PRE – OP EVALUTION:-

1) Pure Tone audiogram :- R →

$$\mathbf{L} \rightarrow$$

Air bone gap

2) Plain X Ray Both Mastoids:-

3) CT – Temporal Bone :-

SURGERY:-

Canal Wall up /canal wall down mastoidectomy done – Side

Date :-

Anas:-

D/B :-

A/B :-

Peroperative Finding:-

POST OPERATIVE FOLLOW UP

Date:

- 1) Post auricular wound suture removal :-
- 2) EAC pack removal :-

POST OPERATIVE FOLLOW UP

Date:	I Month	II Month	III Month	IV Month	V Month	VI Month
SYMPTOMS						
DISCHARGE						
HEARING						
DIZZINESS						
CLINICAL FINDING						
OTO ENDOSCOPIC FINDING						
PTA – AB gap.						

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